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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002952079 for a patent by DARRELL BALLANTYNE COPEMAN as filed on 16 October 2002.

COMMONWEALTH OF AUSTRALIA
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WITNESS my hand this
Thirtieth day of October 2003

J. Billingsley

JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
SUPPORT AND SALES

DARRELL BALLANTYNE COPEMAN

Regulation 3.2

COMMONWEALTH OF AUSTRALIA
Patents Act 1990

PROVISIONAL SPECIFICATION FOR THE INVENTION ENTITLED :

WINCH

This invention is described in the following statement :-

WINCH

Technical Field

This invention relates to an improved winch which has particular but not exclusive application to use in or on vehicles.

Background Art

Winches of many different configurations are known. For use in vehicles, for example to assist a vehicle which has become bogged or for emergency service vehicles, winches are mounted on or adjacent the forward bumper or bull bar and have ranged from the older style capstan winches having a vertical spool, to power takeoff winches and hydraulic winches run off the vehicle gearbox. More recently, electric winches which have an electric motor driven from the vehicle battery have become a preferred winch for use on vehicles. Another form of known winch is an hydraulic winch which uses the vehicles own power steering fluid as the source of fluid to drive the hydraulic motor of the winch.

A major disadvantage of the common electric winches is that the current drain on the vehicle battery can be very high during winch operation. For example, electric winches can draw a current in the order of 500 amps which obviously places a considerable load on a normal vehicle battery which may be only rated at 70 amp/hour. As a result the known electrical winches can only be used for a short period of time before the vehicle battery becomes completely drained. A further disadvantage of electric winches is that they cannot operate underwater.

The known hydraulic winches also suffer a number of disadvantages in that they tend to require a large quantity of hydraulic fluid for their operation and furthermore they tend to heat up rapidly when subject to a load. They also have limited line speed.

A further disadvantage is that in the known winches, the winch spool is often coupled to the spool through a clutch which under load can sometimes disengage resulting in the spool releasing the winch cable and therefore creating the possibility to significant damage or injury.

Summary of the Invention

The present invention aims to provide an improved winch which is particularly but not exclusively suited to use on in connection with vehicles such as four-wheel drive vehicles or emergency service vehicles. The winch of the present invention however may be used in many other applications. Other objects and advantages of the invention

will become apparent from the following description.

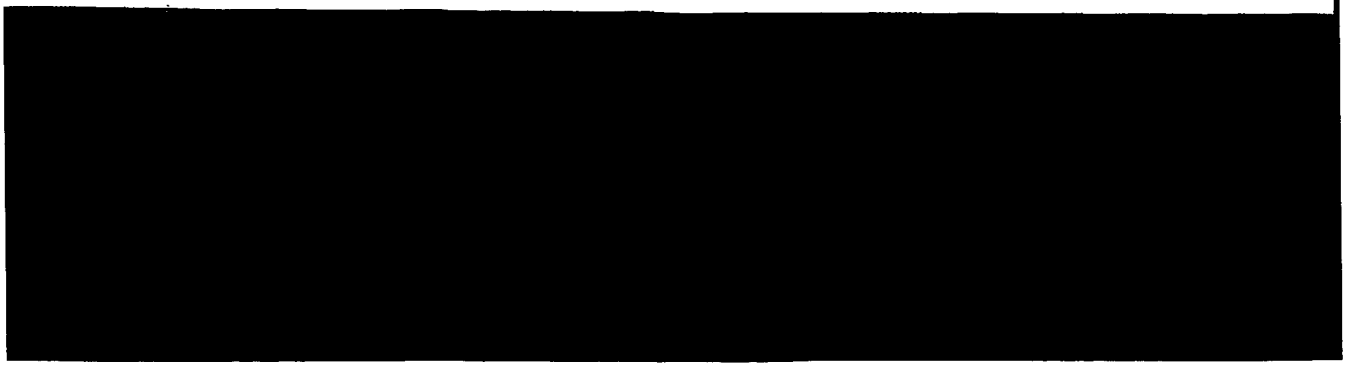
The present invention thus provides in a first preferred aspect a winch having a winch spool, a drive motor, coupling means for coupling said drive motor to said winch spool to effect rotation of said spool and means for preventing disengagement of said drive motor from said winch spool when said winch is subject to a load.

Preferably, the coupling means comprises a clutch which when actuated engages the motor to the spool to effect rotation of the spool and which prevents disengagement of the motor from the spool when the winch is subject to a load. The winch may be subject to a load when a winch cable wound on the winch spool is carrying a load either when the winch is winding in the spool and thus winding in the cable or letting out the cable. The winch may also be subject to a load when not driving the spool for example where the winch cable is still attached to a load.

Preferably, the clutch comprises a dog clutch having clutch members connected to the motor and spool respectively, the clutch members being engaged in the engaged position of the clutch to transmit rotation between the motor and spool. Preferably, the spool is mounted for movement axially of the motor and means are provided to move the spool axially to effect engagement of the clutch members or disengagement of the clutch members.

Suitably, actuating means are proved to move the spool relative to the motor to effect engagement of the clutch. Preferably, the drive motor is an hydraulic drive motor and the actuating means maintains clutch engagement when hydraulic fluid is supplied to the hydraulic winch motor to cause operation thereof. Preferably the actuating means comprises hydraulic actuating means. Suitably hydraulic fluid is supplied to the hydraulic actuating means when hydraulic fluid is supplied to the hydraulic motor to drive the winch spool to maintain fluid pressure on the hydraulic actuating means when the winch carries a load. Braking means may be associated with the hydraulic motor, the braking means being operative to brake the motor and thus prevent spool rotation when the hydraulic motor is not operating. Preferably, the braking means comprises a negative pressure breaking means which is released when fluid pressure is supplied to the motor to cause operation thereof.

The present invention in a further preferred aspect provides a winch assembly including a winch spool, an hydraulic drive motor, means for coupling said drive motor to said winch spool whereby to effect rotation of said winch spool by said drive motor,



hydraulic sup[redacted]eans for supplying hydraulic fluid to said drive m[redacted] and control means for con[redacted]ing the supply of hydraulic fluid from said hydraulic supply means to said hydraulic motor.

Preferably, the hydraulic supply means in one form includes an hydraulic pump and an electric drive motor for the pump and the control means is operative to control the supply of current to the drive motor. Preferably the electric drive motor comprises a low voltage DC drive motor whereby current supply for the drive motor can be provided by a battery or batteries. Preferably, valve means is provided between the hydraulic pump and hydraulic motor of the winch and the control means controls operation of the valve means. Preferably, the control means causes operation of the valve means slightly prior to operation of the hydraulic pump to prevent hydraulic lock-up in the system. The valve means suitably comprises a solenoid operated valve. The valve means is suitably incorporated in a manifold block supplied by the hydraulic pump. The manifold block may include a plurality of auxiliary hydraulic outlets controlled by respective hydraulic valves, suitably solenoid control valves, for connection to other hydraulic accessories.

Preferably, the control means includes a remote control unit which allows cordless remote control of operation of the winch and/or auxiliary hydraulic outlets.

In a further form, the hydraulic pump may be belt driven from the vehicle engine and the control means is operable to control supply of the outlet of the hydraulic pump.

Brief Description of the Drawings

In order that the invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention and wherein:-

Fig. 1 illustrates the general configuration of a winch assembly according to an embodiment of the present invention;

Fig. 2 is an exploded side view of the winch of the winch assembly;

Fig. 3 is a side elevation of the winch in an engaged position;

Fig. 4 illustrates the clutch actuator in plan view;

Fig. 5 is a side elevation of the clutch at one end of the winch spool in a disengaged position;

Fig. 6 illustrates schematically, the main control valve manifold; and

Fig. 7 illustrates the winch hydraulic circuit.

[redacted]

Detailed Description of the Preferred Embodiment

Referring to the drawings and firstly to Fig. 1, there is illustrated the general configuration of a winch assembly 10 according to an embodiment of the present invention including a hydraulic fluid supply in the form of a hydraulic power pack 11 which includes a hydraulic pump 12 and an electric drive motor 13 coupled to the pump 12. The drive motor typically is a 12V or 24V DC motor which may be driven from a battery or batteries typically a battery or batteries of a vehicle. A valve assembly 14 coupled to the pump 12 controls the supply of hydraulic fluid from the pump 12 at a regulated pressure and flow through hydraulic lines 15 and valve unit 16 to an hydraulic winch drive motor 17 of a winch 18. A control unit 19 controls operation of both the valve assembly 14 and the electric drive motor 13. The control unit 19 may include a hard wired switch which when actuated causes through the control unit 19 current to be supplied to the motor 13 of the hydraulic power pack 11 and also actuation of the valve assembly 14 for supply of hydraulic fluid to the winch motor 17 via the valve unit 16.

Alternatively or additionally, the control unit 19 may be controlled by a wireless remote controller 20. The control unit 19 upon receiving a suitable "winch operate" signal from the controller 20 (or hard wired switch) will cause supply of current to the pump motor 13 and actuation of the valve assembly 14. Most preferably, the control unit 19 causes operation of the valve assembly 14 slightly prior to current being supplied to the pump motor 13 to prevent hydraulic lock up in the system. This may be achieved by a suitable time delay circuit in the control unit 19 or by software control. The valve assembly 14 suitably comprises a solenoid operated valve or valves which control fluid supply via the hydraulic lines 15 to the motor 17. The valve assembly 14 may include a number of auxiliary outlets 21 for supply of hydraulic fluid to different accessories such as hydraulic jacks or hydraulic power tools. The auxiliary outlets 21 may also be controlled by solenoid control valves which may be actuated by the remote control unit 20 or alternatively or additionally by hard wired switches.

The winch motor 17 is coupled to a winch spool 22 through a clutch 23 which includes a clutch actuator 24 controlled by the valve unit 16. The clutch actuator 24 prevents disengagement of the clutch 23 when a load is on the winch 18 as described further below

The winch 18 as shown more clearly in Figs. 2 to 5 includes a support frame 25 comprising end frame members 26 joined by spacer bars 27. The frame members 26

have flanges 2[redacted]ich enable mounting of the winch 18 as required [redacted]s to a standard winch base bolt mounting. The hydraulic motor 17 is mounted to one of the frame members 26 and a drive plate 28 of the clutch 23 is keyed to the drive shaft 29 of the hydraulic motor 18, the drive plate 28 having a central boss 30 and in instance four driving pins or dogs 31 which extend in an axial direction and are arranged at a common radius from the axis X-X of rotation of the drive plate 28 and at equal circumferential spacing around the drive plate 28. A bearing assembly 32 is provided on the other end frame member 26 and rotatably supports a stub axle 33. Both the boss 30 of the drive plate 28 and stub axle 33 have the same external diameter.

The winch spool 22 includes a main hollow cylindrical spool body 34 which is supported at opposite ends by the boss 30 and stub axle 33 respectively, the body 34 having an internal diameter substantially the same as the external diameter of the boss 30 and axle 33. The winch spool 22 is thus supported for rotation about the axis X-X. Further the spool 22 is capable of limited longitudinal or axial movement along the axis X-X for a purpose which will hereinafter become apparent.

Annular end plates 35 and 36 are fixed at opposite ends to the spool body 34 and in addition, the spool body 34 carries a further annular plate 37 spaced inwardly from the plate 36 and defining therewith an annular channel 38. The plate 36 also includes a four spaced apertures 39 arranged at the same radius as the pins 31 and at the same circumferential spacing, the apertures 39 having an internal diameter substantially the same as the external diameter of the pins 31. The pins 31 mounted on the plate 38 and apertures 39 in the end plate 36 form a dog clutch for transmitting drive directly from the hydraulic drive motor 17 to the spool 22 as described further below.

The support frame 25 also carries a clutch actuator assembly 40 which includes a lever arm 41 mounted at 42 to the frame member 26 which supports the motor 17 for pivotal movement about an axis extending substantially normal to the axis X-X of rotation of the spool 22. A bearing wheel 43 is mounted at one end of the arm on an axle 44 and is located in the channel 38 to bear on the respective plates 36 and 37. The opposite end of the arm 41 is connected to a one-way hydraulic actuator 45 The arm 41 is also extended beyond the mounting 42 and terminates in a manual release knob 45 which in the absence of pressure on the actuator 44 or load on the winch 18 enables manual movement of the spool 22 in opposite directions along the axis X-X to engage or disengage the clutch 23.

[redacted]

In the disengaged position of the clutch 23 as shown in Fig. [redacted] spool 22 is capable of free wheeling such that cable 46 wound on the spool 22 may be unwound so as to enable it to be coupled to a load or anchoring point . When the controller 20 is operated to actuate the pump motor 13 and valve assembly 14 to cause hydraulic fluid under pressure to be supplied from the pump 12 to the motor 17 through the valve unit 16, the hydraulic motor 17 will be actuated causing rotation of the shaft 29 and drive plate 28. At the same time, fluid pressure is applied through the valve unit 16 to the clutch actuator 45 to apply a pivoting force to the lever arm 41 which causes through the bearing wheel 43 acting on the spool end plate 36, an axial force on the end plate 36 to urge it towards the drive plate 28 so that it abuts the ends of the pins 31. The frictional force between the ends of the pins 31 and the plate 36 will cause the spool 22 to rotate and wind in the cable 46. When however the load is taken up and tension begins to be applied to the cable 46, the plate 36 will slip and rotate relative to the plate 28 as the clutch 23 is not engaged. Relative rotation between the plate 36 and 28 will move the pins 31 on the plate 28 into alignment with the respective apertures 39 in the plate 36 at which position, the pins 31 will locate in the aperture 36 with the plate 36 and spool 22 being urged axially along the axis X-X by the actuator 44 towards the motor 17. Drive will thus be transmitted directly from the motor 17 to the spool 22 and effect positive rotation of the spool 22 and winding in of the cable 45. If the pins 31 are aligned with the apertures 39 when fluid pressure is applied to the actuator 45, the clutch 23 will be immediately engaged however in most cases, this will not occur. Whilst the fluid pressure remains applied to the valve unit 16 from the pump 12, the clutch 23 cannot be disengaged. Similarly, whilst the load remains on the winch 18 through the winch cable 46, the clutch 23 cannot be disengaged without taking the load from the cable 46. Thus there is no risk of inadvertent release of the cable 46 and load.

Fig. 6 illustrates schematically the valve assembly 14 including a manifold block 47 which incorporates solenoid valves 48 and 49. The solenoid valve 48 may be actuated by the remote controller 20 to supply fluid from the pump 12 (indicated at P) to outlet A2 or B2 (depending upon the required direction of winch operation) and return fluid to the hydraulic reservoir (indicated as T.). A further solenoid valve 49 can be actuated by the controller 20 to supply fluid to auxiliary devices through outlet A3 or B3. The manifold block 47 can include a number of valves 49 for supplying different auxiliary devices. Pilot valves PV may be provided in the auxiliary circuits to prevent

creep with single action rams.

The outlets A2 and B2 are coupled to inlets V1 and V2 of a further valve block 50 of the valve unit 16 containing fluid actuable valves 51 and 52. Supply of hydraulic fluid to either inlet V1 and V2 will cause actuation of the valve 51 and 52 to supply fluid to, and return fluid from, the hydraulic winch motor 17 via connections C1 or C2 depending upon the required direction of rotation of the winch spool 22. Fluid pressure applied to either inlet V1 or V2 will be applied via a one-way ball shuttle valve 54 through line 53 to the clutch actuator 44 to maintain clutch engagement irrespective of the direction of rotation of the motor 17 and winch spool 22.

If a load remains on the winch cable 46 after the winch motor 17 ceases operation, the clutch 23 also cannot be disengaged as although fluid pressure is relieved on the supply side of the winch motor 17, fluid pressure is maintained in the actuator supply line 53. That pressure will not be relieved until the motor 17 is reversed. This therefore prevents inadvertent release of the cable 46. The clutch 23 may then be manually disengaged by force applied to the handle 46 (a clockwise force in Fig. 4) to move the spool 22 to the clutch disengage position of Fig. 5 after which the spool 22 may be freely rotated.

To prevent hydraulic overload due to excessive loading on the winch 18, the pump 12 may be provided with a pressure relief valve so as to relieve excess pressures and direct hydraulic fluid to the reservoir to thereby prevent winch overload.

The hydraulic motor 17 may also include a negative pressure brake to prevent motor creep. The brake will be released at any time that fluid is applied to motor 17 via connections C1 or C2. Where there is no fluid pressure at connection C1 or C2, the brake will be applied to prevent rotation of the motor shaft and maintain the shaft locked against rotation thereby eliminating possible creep due to hydraulic pressure losses. The brake may also be released by reversing the hydraulic motor 17.

The winch assembly 10 can operate under control of the valve assembly 14 either to wind in the winch cable 46 in which case the winch motor 17 is operating in one direction or operated in the opposite direction, for example to let out cable 46 under load.

The winch 18 being hydraulically driven may be used in underwater situations in water or in mud for extended periods of time as all electrical components are associated with the hydraulic power pack 11. The use of the remote controller 20 allows the

[redacted]

operator to wo[redacted]y from the danger zone of winch cable or vehicl[redacted]g winched. This is further facilitated by using the winch cable 46 as an aerial extension for receipt of control signals from the controller 20, the control unit 19 being configured such that its receiving aerial is formed by the body of the winch 18 and connected winch cable 46. As operation of the winch 18 automatically engages the clutch 23, the operator is not required to return to the winch 18 to commence operation.

The actuator assembly 40 may be mounted at other positions on the frame 26 as shown in dotted outline in Fig. 3 and as an alternative may be mounted at the opposite end of the winch 48 with in this case the plate 37 being located adjacent the end plate 35 to define therewith the channel 38 for receipt of the bearing wheel 43. The actuator assembly 40 may of course be in many different configurations other that that described and illustrated to effect movement of the spool 22 axially for clutch engagement.

Whilst the winch assembly is suitably provided with its own hydraulic power pack, it may be connected to an existing hydraulic system if available and of course the may be connected to a system where a hydraulic pump is belt or PTO driven. The hydraulic power pack however is preferred in many situations as the winch 18 can then be operated without a vehicle motor operating.

Whilst the above has been given by way of illustrative embodiment of the invention, all such modifications and variations thereto as could be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of the invention as herein set forth.

Dated this sixteenth day of October 2002

DARRELL BALLANTYNE COPEMAN
By His Patent Attorney

JOHN R.G. GARDNER

[redacted]

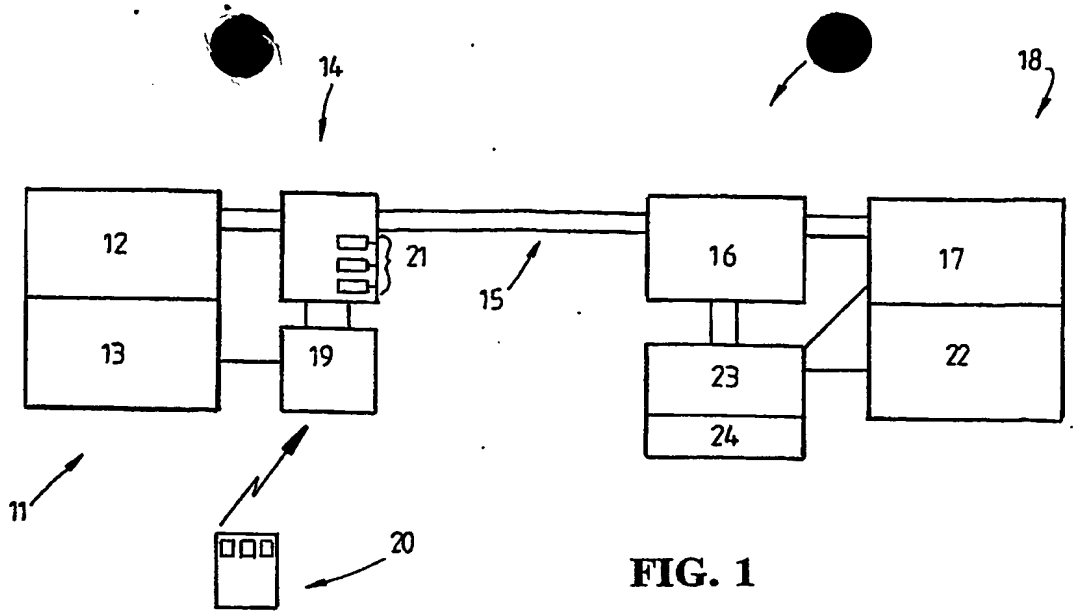
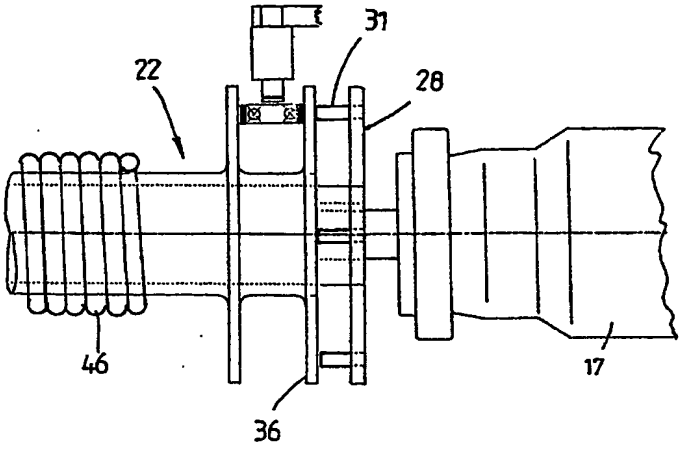


FIG. 1



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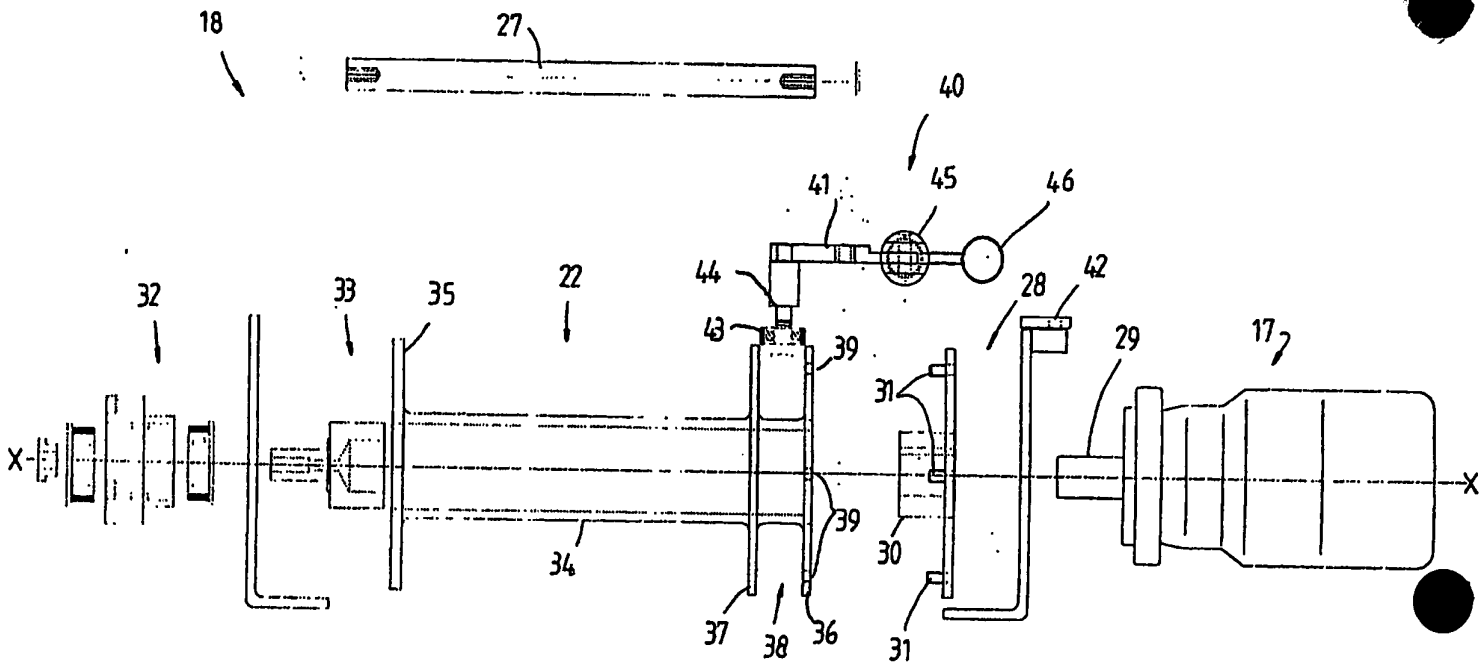
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FIG. 2

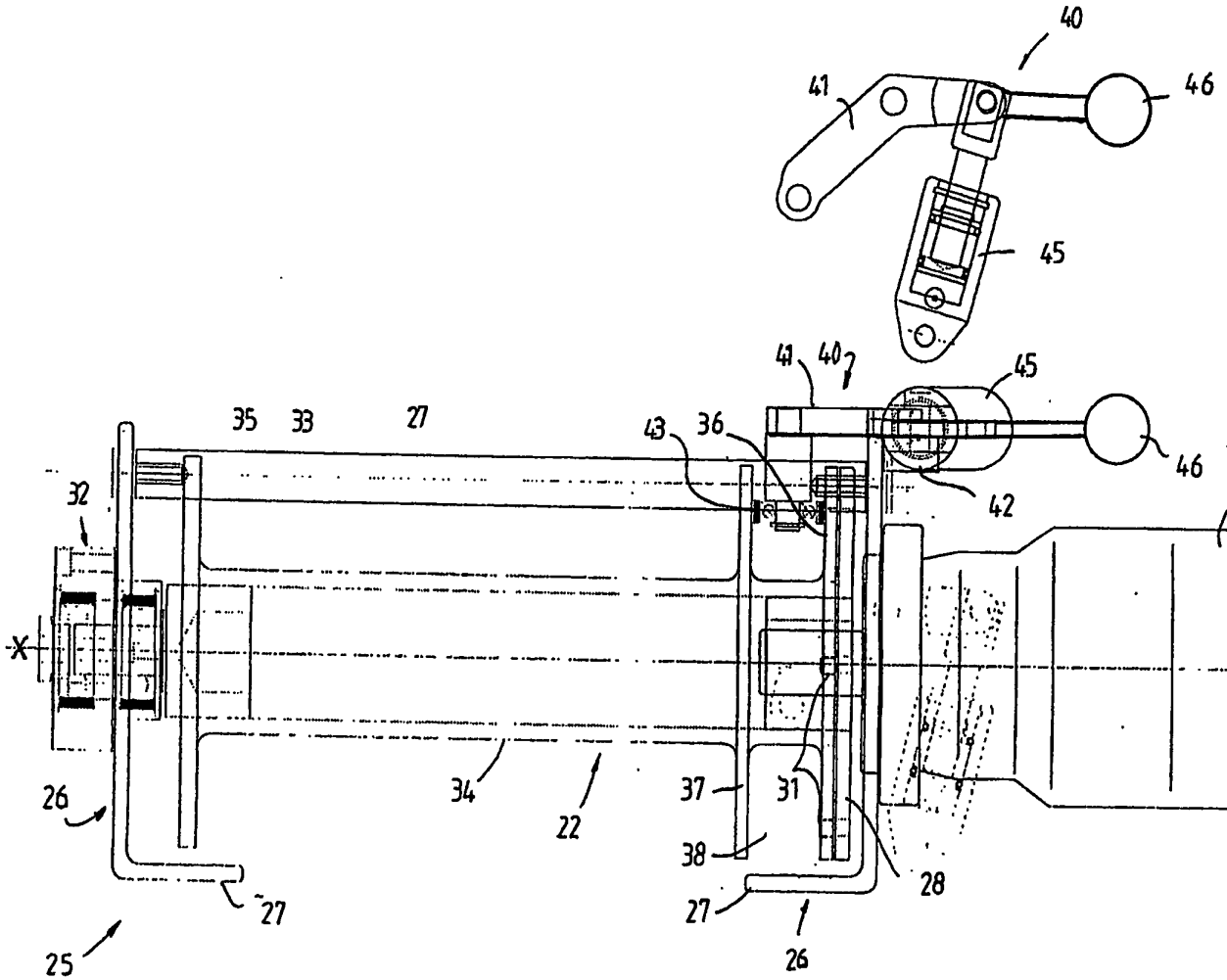
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FIG. 4

FIG. 3

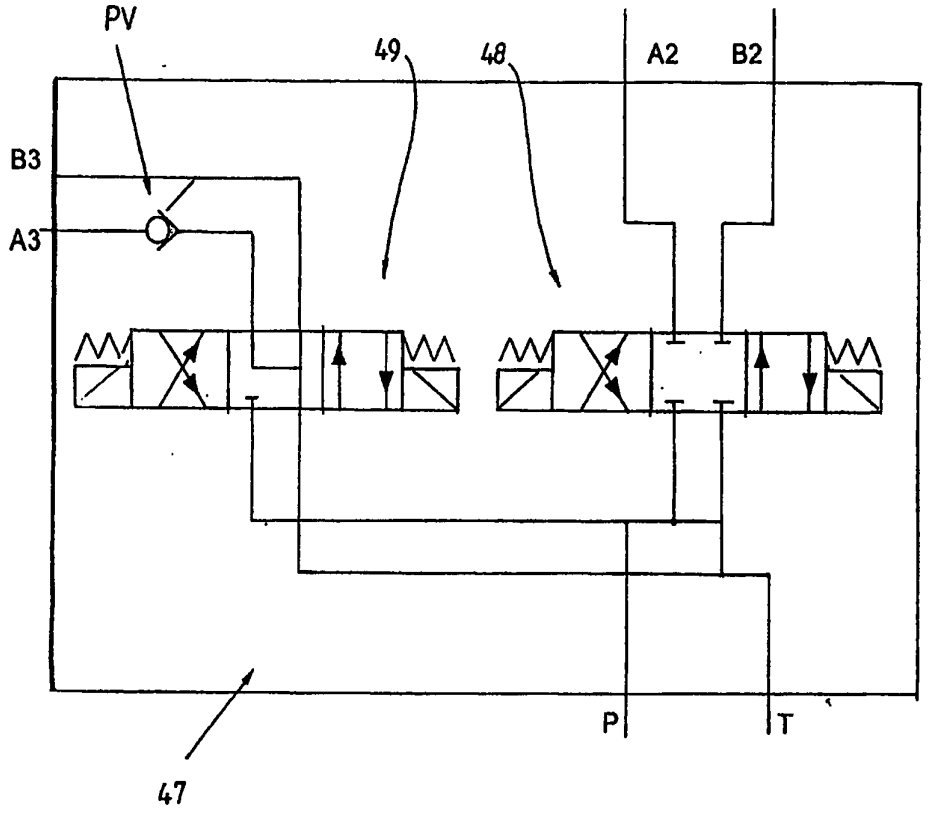
PV
49
48
A2
B2
B3
A3
P
T
47

FIG. 6

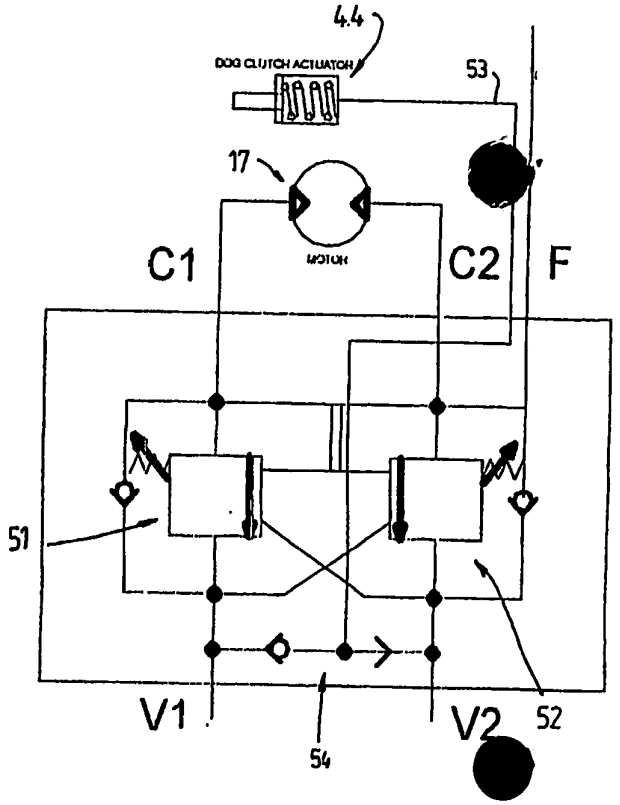
4.4
DOG CLUTCH ACTUATOR
53
17
MOTOR
C1
C2
F
51
V1
V2
52
54

FIG. 7